DRYING FARMERS' STOCK PEANUTS WITH INTERMITTENT EXPOSURES TO HEATED AIR

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DRYING FARMERS' STOCK PEANUTS WITH INTERMITTENT EXPOSURES TO HEATED AIR

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SUMMARY

Three types of farmers' stock peanuts (Runner, Spanish, and Virginia) were dried during three seasons on an experimental belt-type dryer to investigate the effects of temperature, airflow rate, length of exposure to heat, and length of aeration between heat treatments on various quality factors of the peanuts. Short exposures to heat, combined with mixing, tempering, and aerating the peanuts between exposures, allowed the use of higher temperatures and resulted in a much shorter total time exposure to heated air than conventional methods. Air temperatures to 145° F. were used on Starr Spanish- and Early Runner-type peanuts without undue reduction of quality.

Drying newer varieties of Virginia-type peanuts with air temperatures at 115°, 130°, and 145° F. resulted in excessive split kernels.

INTRODUCTION

At harvesttime, peanuts grown in the southeastern United States generally contain about 40 to 50 percent moisture. This moisture must be reduced immediately and drying completed within a few days or molds may develop on the peanuts causing spoilage or lowering of quality. This problem is especially critical at warm temperatures and high humidities. Interest in artificial drying has been intensified recently by the concern over contamination of peanuts by mycotoxins—aflatoxin in particular.

The most common harvesting practice is to machine dig peanuts and leave them in the fields in a windrow to dry on the vine. When the peanuts reach a moisture content of about 20 percent, they are then picked from the vines, further dried artificially to about 7-percent moisture content, and then stored. Since windrow drying may require several days, depending upon the geographic area and weather, peanuts left in the field to dry to a moisture content below 20 percent are very susceptible to mold and mycotoxin contamination.

To reduce field losses (losses of pods in or on the ground) and to reduce further the risk of mycotoxin contamination in the field, there is a trend toward picking peanuts at moisture contents above 20 percent, even though more artificial drying is then necessary. When peanuts are dried to 20-percent moisture content in the field, field losses are often high (sometimes as much as 25 percent) as a result of deterioration in the strength of the pegs (stringlike connection between pod and vine) once the peanut kernel has reached maturity. Farmers who have picked peanuts at moisture contents above 20 percent have found that the peanuts saved have more than offset the added cost of the additional artificial drying necessary to reduce the peanut moisture content to storage level.

When the peanuts are picked at high-moisture contents, artificial drying must begin immediately to avoid them being damaged by mold. The most popular drying method is the trailer-bin drying system. These bins are

equipped with false floors through which heated air from direct-fired gas burners is moved into and through the column of peanuts. This air is forced vertically upward through the peanuts until the moisture content of the upper layers reaches about 10 percent. Since the peanuts in the lower part of the bin dryer are constantly exposed to air of high-drying capacity, air of moderate temperature and humidity must be used to prevent their damage from overdrying or drying too rapidly. However, when air of moderate temperature and humidity is used, peanuts in the upper part of the bin remain at a high-moisture content for some time. Conditions may be favorable for mold growth in the peanuts near the top of the column during this period, particularly if the peanuts were picked at high-moisture content or a low airflow rate is used. Bin dryers are normally considered inadequate for "green" harvested peanuts.

Extension engineers in the peanut-producing areas recommend that peanuts be dried at air temperatures not exceeding 95° F. and at relative humidities no lower than 55 percent (*5*, *6*, *9*).[1] Even with these moderate conditions, the moisture content of kernels constantly exposed to the air where it enters the column will be reduced to 6 percent (*1*), which will result in a loss in quality when the peanuts are prepared for market.

The uniformity of drying can be improved to some extent by increasing the airflow rate per unit volume of peanuts. When air is moved upward through a drying bin, a higher airflow rate will increase the depth of the drying zone, reduce the drying time, and result in more uniform moisture content from top to bottom of the column. However, increasing the airflow rate increases the horsepower requirements rapidly. (Power required by fans is proportional to the third power of the airflow rate.) Excessive airflow rates often cause a potential drying zone to be greater than the depth of the peanut column. Then, the air does not become saturated with moisture and drying efficiency is reduced. If the air enters the column at low relative humidity and leaves the upper layer of peanuts at saturation, or at equilibrium with the peanuts, the drying will be at maximum efficiency.

In 1965, Hutchison (*3*) obtained improved drying by intermittently reversing the direction of airflow. This prevented the constant exposure of the same peanuts to air of maximum drying capacity, reduced the differential in moisture content between peanuts at the top and bottom of the column, and resulted in higher quality peanuts. Commercial trailer-bins have been built to use this method; however, moderate temperatures are required if continuous exposure to the heated air is used.

Drying also will be more uniform if the peanuts are blended periodically so that the same peanuts are not continuously exposed to the air of maximum drying capacity. Investigations described in this report not only used this technique but also used air at temperatures higher than ordinarily recommended for drying.

The ability of peanuts to withstand high temperatures for extended periods of time and high-drying rates is still questionable, and many variables are involved. The depth of the column of peanuts is important if the peanuts are not mixed frequently. The moisture content of the peanuts and the duration of their exposure to heat are also important.

Tests in North Carolina (*1*) indicate that at relative humidities above 60 percent, milling quality of Virginia-type peaunts was not affected by temperatures up to 105° F. (highest temperature tested in this humidity range). In the same tests, milling quality was consistently lower when drying air was at a relative humidity below 60 percent. For equal drying rates, Dickens[2] found a direct relationship between drying temperature and off-flavor in immature peanuts dried at 95°, 105°, and 115°. Kunze and others (*7*) found that peanuts dried rapidly (up to 5 percent per hour) under vacuum did not develop off-flavor. Milling quality of the peanuts was affected adversely, however, in some of these tests. Although the cause was not isolated, it could have been due to the

[1] Italicized numbers in parentheses refer to Literature Cited, p. 25.

[2] DICKENS, J. W. CURING METHODS AND TECHNIQUES AS INFLUENCING QUALITY. 1960. Peanut Improvement Working Group, Membership Meetings Minutes.

high-drying rate, overdrying, high temperature, or drying through too great a moisture content range. Most of the samples were dried to below 4-percent dry basis. Pickett (*12*) concluded from vacuum drying of shelled peanuts that the time factor alone apparently is not of great significance in obtaining a satisfactory product. He also concluded that peanuts dried with 120° F. air are more likely to develop undesirable flavors than peanuts dried either at higher or lower temperatures.

Aristizabal [3] found no significant difference in organoleptic attributes of flavor, color, texture, and product acceptance for peanuts from 10 series of tests in a vacuum dryer. The tests ranged in severity from 48 hours at 80° F. to consecutive exposures of 3, 5, and 15 hours in the dryer with wall temperatures of 150°, 130°, 90°, respectively. He stated, however, that the temperature reached by the peanuts was not known and may have been considerably lower than the indicated wall temperatures of the dryer because of evaporative cooling.

For continuous exposures of peanuts to the various drying conditions, research indicates that the temperature at which peanuts are dried affects their flavor, but not necessarily their milling quality. Conversely, a high-drying rate seems to affect their milling quality, but not necessarily their flavor. Since a high-drying rate is usually obtained by using a high temperature, both milling quality and flavor usually are affected adversely if peanuts are continuously exposed to high temperatures.

Some researchers have used relatively high temperatures with intermittent exposures of the peanuts. Farouk [4] found that Spanish-type peanuts of the Starr variety could be dried from 40 to 6 percent moisture content in 48 hours, with little effect on milling quality, by using intermittent heating up to 120° F. A variety of tempering and aerating periods occurred between heat exposures.

Drying by intermittent exposures to infrared radiation indicated that Spantex Spanish-type peanuts dried from an original moisture content of 18 to 22 percent were superior organoleptically to those dried from higher moisture levels and also to those dried with ambient air.[5]

Tests at Texas A&M University (*8*) in 1965 indicated that both ½- and 1-minute exposure of peanuts to infrared radiation, with aerating and tempering between exposures, were too severe and resulted in lower milling quality. Temperature of the peanuts after passing through the dryer averaged up to 143° F. for the 1-minute exposure and up to 125° for the ½-minute exposure However, tests the following year, using slower heating procedures, resulted in only 5.5 percent splits with intermittent heating up to 120° pod temperatures. Heating to 130° and 140° was less favorable.

Although many variables are involved, peanuts seem more tolerant to severe drying methods when only intermittent exposures are involved.

MATERIALS AND METHODS

The investigation described herein involved exposing peanuts intermittently to heated air in conjunction with tempering, aerating, and blending.

The tests were conducted in Dawson, Ga., during the fall of 1965, 1966, and 1967, and in the Suffolk, Va., area in the fall of 1966 and 1967. Three types of peanuts were dried in Georgia and one type in Virginia. In 1965 and 1966, some peanuts were allowed to dry to various levels of moisture content in the field, but in 1967 all were picked immediately after digging. The peanuts were transferred from the combine into pallet bins of about 50-cubic-foot capacity and taken to the drying plant. These bins had self-cleaning cone bottoms that

[3] ARISTIZABAL, LEON. CURING AND DRYING EFFECTS UPON THE QUALITY OF SPANISH PEANUTS. 1967. (Unpublished master's thesis, Texas A&M University Library.)

[4] FAROUK, S. H. DRYING SPANISH PEANUTS WITH INTERMITTENT HEATING, AERATING AND TEMPERING PROCESSES. 1967. (Unpublished master's thesis, Texas A&M University Library.)

[5] NORRIS, J. R. THE EFFECTS OF INFRA-RED DRYING UPON SPANISH PEANUT QUALITY. 1967. (Unpublished master's thesis, Texas A&M University Library.)

were perforated to facilitate aeration of the peanuts between exposures to heated air.

The dryer used had two sections and was designed for versatility in conducting peanut-drying experiments. Each of the two sections of the dryer consisted of a 3-foot wide, wire-mesh belt which passed over two 4-foot long plenum chambers (figs. 1 and 2).

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FIGURE 1.—Test facility with two-section dryer.

Individual fan-burner units supplied air to each chamber. The burners were gas-fired and were regulated by a motorized modulating valve which acted to maintain a preset temperature of air entering the chamber. The air temperature was recorded on a 24-hour chart. Airflow rates per cubic foot of peanuts were 30 cubic feet per minute (c.f.m.) in 1965 and 40 c.f.m. in 1966 and 1967.

The peanuts were cleaned after being transferred from the field and then were dropped onto the belt from the pallet bins through a hopper over the dryer.

In the 1965 tests, peanuts remained on the belt for about 18 hours, receiving heated and ambient air intermittently. In 1966 and 1967, the peanuts were dried by 1-hour passes over the dryer every 5 hours. The peanuts were tempered for 30 minutes to 1 hour after each pass, then aerated with 1 c.f.m. of air per cubic foot of peanuts for the remaining time between passes. The peanuts were moved from the dryer to pallet bins for aeration. Aeration was provided by small fans attached to the bins.

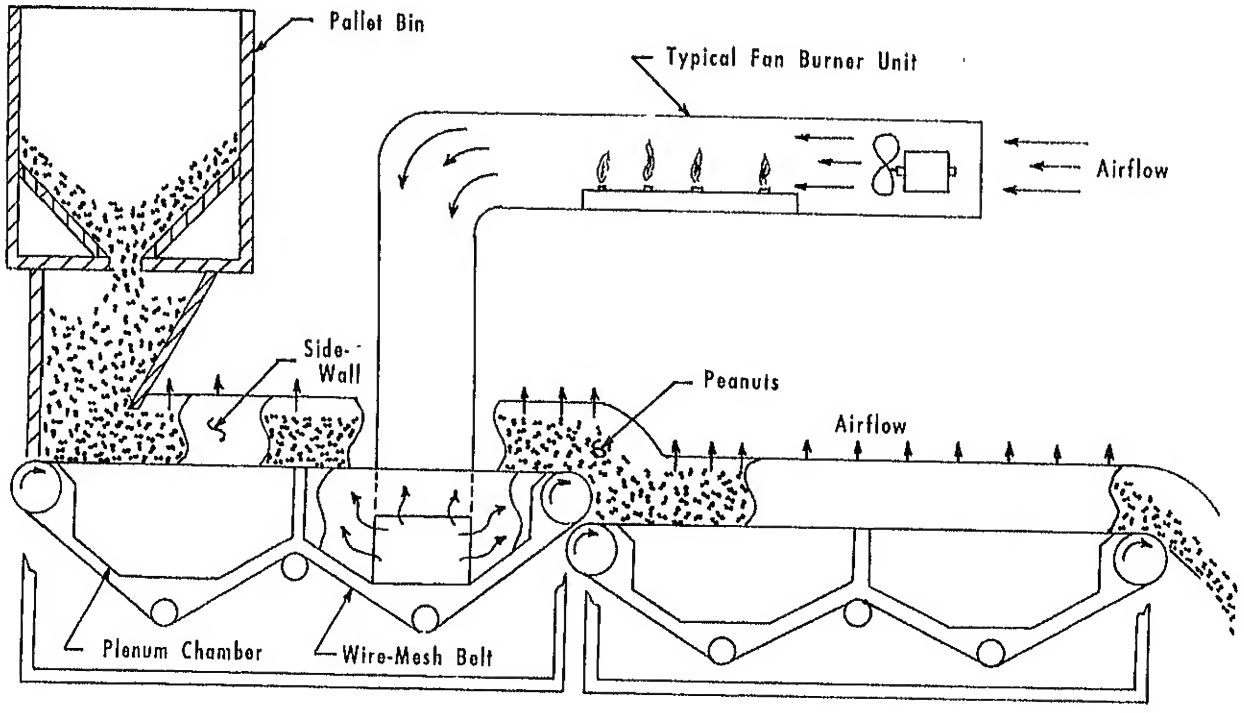

FIGURE 2.—Schematic cross section of belt drying facility.

Although all peanuts remained on the belt for 1 hour, the time of exposure to heat was varied from test to test by idling selected burner units. Thus, on some hourly runs, peanuts were exposed intermittently to 7.5 minutes of heated air and 7.5 minutes of ambient air. On other hourly runs, 15- and 30-minute periods of exposure to heat were used with corresponding periods of exposure to ventilation with ambient air required to total 60 minutes. One test was run in which the peanuts were exposed to heat for the full 60 minutes.

In 1965, peanuts from only one harvest date were used for the tests of each type of peanut. However, in 1966 and 1967, two different harvest dates were required for the tests of each type of peanut to complete all tests. These tests are grouped by harvest date in reporting the data, and average values of the two groups are shown separately.

To prevent physical damage, mechanical handling of the peanuts was eliminated or minimized as much as possible. For tests during the first 2 years, the dryer was arranged so that the peanuts fell directly from the end of the belt into the awaiting pallet bin. In later tests, the peanuts were lifted into the bins by elevators or conveyors.

The individual lots of peanuts were weighed before and after each test. The moisture content of peanuts before starting the tests were determined by the oven method developed by the Southern Marketing and Nutrition Research Division (*2*). At lower levels of moisture content (up to 24 percent), a Motomco moisture meter was used. Moisture content at time of shelling has been observed to be an important parameter and is shown with other data in the tables.

In 1965, a series of tests was run for controls as a standard of comparison. In some of these tests, peanuts of each type were dried in bin dryers with various methods of air movement and at various temperatures. Peanuts were placed in the bins to a depth of about 3 feet. In the other control tests, some peanuts were dried completely in windrows. In 1966 and 1967, some of the peanuts tested for controls were dried with ambient air on a sample dryer for flavor evaluations, while others were dried in bins for milling quality evaluations.

Results of quality measurements using official grade, flavor, and aflatoxin assay of the peanuts from the control tests were compared with corresponding data from samples of peanuts from the heated air test series.[6]

In 1965 and 1966, the flavor analyses were rated by trained test panels of 10 members and consisted of paired comparisons for off-flavor detection. Each member of the panel compared a sample of peanut butter prepared from the peanuts from each individual drying test with one prepared from control peanuts dried with ambient air. In 1967, the rating procedure was changed from previous years and each member of the panel rated the flavor of peanut butter prepared from the peanuts from each test, numerically, from very poor (5) to excellent (1). Although members of the panels varied from year to year, standard procedures were used in selecting and training the members to achieve comparable results.

The peanuts from each test were shelled, with their identity preserved, in a commercial-type shelling plant equipped to determine the makeup of the shelling outturn. The percentage of split kernels was used as the primary indicator of milling quality.

RESULTS

The drying rates, flavor ratings, and percentages of split kernels for the peanuts in the 1965 tests are shown in tables 1, 2, and 3. Spanish peanuts from the tests with the belt dryer (table 1) yielded more split kernels than those from the tests with the bin dryer, but they dried considerably faster. In tests using a heated air exposure time of 7.5 minutes, the peanuts were better from the standpoint of milling quality and drying rate than those in tests using other exposure periods. However,

[6] Aflatoxin assays and flavor analyses were evaluated by Charles E. Holaday and Jack L. Pearson of Field Crops and Animal Products Branch, Market Quality Research Division, Agricultural Research Service, U.S. Department of Agriculture.

TABLE 1.—*Percentage of split kernels, drying rate, and number of off-flavors in belt-dried and bin-dried Argentine Spanish peanuts, crop year 1965*

Air temperature (° F.) and exposure time	Kernel moisture		Split kernels	Drying rate per hour based on—		Off-flavors [1]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	*Number*
Belt dried						
115°:						
7.5 minutes [2]	20 4	8 5	3 5	2.9	1 4	0
15.0 minutes	24 4	7 6	7 5	1.8	9	2
30.0 minutes	26 7	7 4	7 0	2 0	1 0	1
60.0 minutes	24 6	7 8	5 0	1.8	9	0
Average	------	------	5 8	2 1	1 0	8
130°:						
7.5 minutes [2]	28 1	7 9	5 1	2 5	1 2	3
15.0 minutes	23 9	7 6	7 9	2.0	1 0	1
30.0 minutes	17 7	8 2	7 2	1 6	8	3
60.0 minutes	20 4	7 9	5 8	1 4	.7	3
Average	-----	------	6 5	1 9	9	2 5
145°:						
7.5 minutes [2]	28 3	7 9	6 0	3 0	1 5	-------
Bin dried (control)						
Ambient:						
Continuous	24 9	8.1	3 6	------	.2	0
100°:						
Continuous	24 9	7 3	4 7	.4	4	3
125°:						
Heat, 60 minutes-ambient air, 60 minutes [3]	24 9	8 1	3 7	1.4	.7	1
110°:						
Heated and ambient air, 60 minutes [4]	19 9	7 4	2.0	.8	4	-------
125°						
Heated and ambient air, 60 minutes [4]	21 5	7.3	3 9	1.0	.5	-------
Average	-----	------	3 6	.9	.44	1.3
Windrow test	-----	9 0	5 1	------	------	-------

[1] Number of panelists reporting off-flavor from a 10-member panel. Information provided by J. L. Pearson, horticulturist, Market Quality Research Division.

[2] Peanuts dried in passes of 1 hour each, followed by mixing and tempering between passes.

[3] Peanuts dried by intermittent heat and ambient air forced from alternate directions for periods of 60 minutes each.

[4] Peanuts dried by alternating exposures of heated air and ambient air, both for 60 minutes and from the same direction.

TABLE 2.—*Percentage of split kernels, drying rate, and number of off-flavors in belt-dried and bin-dried Early Runner peanuts, crop year 1965*

Air temperature (° F.) and exposure time	Kernel moisture		Split kernels	Drying rate per hour based on—		Off-flavors [1]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	*Number*
Belt dried						
115°:						
15.0 minutes	18.1	7.6	1.7	1.4	0.7	1
30.0 minutes	16.2	7 4	2 2	2.2	1.1	0
60.0 minutes	19.0	7.7	1 6	1.5	.8	5
Average	-----	------	1.8	1.7	.9	2.0
130°:						
15.0 minutes	15.0	7.9	1.5	1.3	.6	2
30.0 minutes	17.3	7.6	2.5	1.8	.9	3
60.0 minutes	17.8	7.5	1.8	2 4	1.2	1
Average	-----	------	1.9	1.8	.9	2.0
145°:						
15.0 minutes	17.3	7.3	3.8	2.4	1.2	0
30.0 minutes	16.8	6 9	3.8	1.5	.8	1
60.0 minutes	17.0	6 8	3.5	1.8	.9	0
Average	------	------	3.7	1.9	1.0	.3
130°:						
15.0 minutes, high moisture	35 1	6.6	7.3	2.0	1.0	-------
145°:						
15.0 minutes, high moisture	35.3	6.6	19.7	2.7	1.4	-------
Bin dried (control)						
100°:						
Continuous	19.7	6.7	2.5	.5	.5	0
Ambient:						
Continuous	19.7	7.4	1.7	0	.2	1
145°:						
Heated and ambient air, 60 minutes [2]	19.7	6.6	5.6	1.7	.8	0
Average	------	------	3.3	1.1	.5	.3
Windrow test	------	7.3	.8	------	------	-------

[1] Number of panelists reporting off-flavor from a panel of 10 persons. Information provided by J. L. Pearson, horticulturist, Market Quality Research Division.

[2] Peanuts dried by intermittent heat and ambient air forced from alternate directions for periods of 60 minutes each.

TABLE 3.—*Percentage of split kernels, drying rate, and number of off-flavors in belt-dried and bin-dried Virginia Florigiant peanuts, crop year 1965*

Air temperature [1] (° F.) and exposure time	Kernel moisture		Split kernels	Drying rate per hour based on		Off-flavors [2]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	*Number*
Belt dried						
115°:						
15.0 minutes	42 3	7 7	12 7	1 8	0 9	4
30.0 minutes	40 6	7 6	13 6	1 7	.9	6
60.0 minutes	41 7	7.9	18 0	1 5	.8	1
Average	-------	------	14 8	1 7	9	3 7
130°:						
15.0 minutes	40.0	7.5	23 3	1 7	8	2
30.0 minutes [3]	41.3	7 7	20.2	2.6	1 3	4
60.0 minutes	41.7	8 1	19.6	2 1	1 0	6
Average	-------	------	21.0	2 1	1 0	4.0
145°:						
15.0 minutes	44.7	9.0	8 4	2 3	1 1	7
30.0 minutes	44 5	8.8	6.8	2 3	1 1	5
60.0 minutes [3]	45 0	8 0	13.0	2.7	1 4	7
Average	-------	------	9.4	2 4	1 2	6.3
Bin dried (control)						
100°:						
Continuous	20.9	8.1	5.1	.4	3	2
Ambient:						
Continuous	20.9	8.3	2.8	------	.3	1
145°:						
Heated and ambient air, 60 minutes [4]	20 9	7.9	10.0	1.4	.7	2
Average	-------	------	6 0	9	4	2.7
Windrow test	-------	7 5	8.8	------	-	-------

[1] The belt-dried peanuts received alternate 15-minute exposures of 200° F. air and ambient air during the first hour of drying at a 4-inch depth.

[2] Number of panelists reporting off-flavor from a panel of 10 persons. Information provided by J. L. Pearson, horticulturist, Market Quality Research Division.

[3] Peanuts received no forced air for 20 to 48 hours during the drying process because of equipment failure. This time was not included in the total drying time in computing the drying rate, although some drying perhaps took place.

[4] Peanuts dried by intermittent heat and ambient air forced from alternate directions for periods of 60 minutes each.

the peanuts in the tests using a heated air exposure of 7.5 minutes were dried in 1-hour passes, with mixing and tempering after each pass, while peanuts in the tests using other exposure lengths were dried in 18-hour periods, without mixing or tempering. This mixing and tempering apparently resulted in the improvement. Indications of off-flavor were more prevalent in peanuts dried at 130° than at 115° F.

Data from the tests on Early Runner peanuts (table 2) indicate that excellent quality resulted from drying peanuts at 115° and 130° F. Although about the same amount of split kernels resulted from drying these peanuts in bin dryers, drying was considerably faster on the belt dryer. Peanuts from the 145° belt tests yielded higher split kernels, but the milling quality was exceptionally good. However, peanuts in the tests run at 130° and 145° at high-moisture content exhibited much poorer milling quality. Fewer off-flavors were indicated for peanuts dried at 145° than at 115° or 130°.

Virginia peanuts dried on the belt dryer (table 3) were "green" harvested at a moisture content above 40 percent. Splitting was rather high for peanuts in these tests, except at 145° F., at which temperature the percentage of split kernels was lower. Off-flavors were higher with high temperatures. Since peanuts dried on the belt dryer had a higher initial moisture content than those dried in bins, the results of the two types of tests cannot be compared. In the control tests, milling quality was consistently lower for peanuts dried with heated air. Less off-flavor was detected in the peanuts of lower initial moisture content that were dried in bins.

To summarize the 1965 tests, results showed that drying peanuts from about 20-percent moisture content at a 1-foot depth with intermittent heat was faster than drying peanuts in a bin using intermittent heat forced from alternate directions. However, there was some sacrifice in milling quality. The use of 1-hour passes, with tempering and mixing between passes, apparently improved milling quality and drying rate. Flavor was not significantly impaired by any of the treatments. Virginia peanuts harvested at high-moisture content exhibited rather high damage after most of the tests and had more objectionable flavor.

The results of the 1966 tests are shown in tables 4, 5, 6, and 7. All the peanuts in these tests were dried on the belt dryer in 1-hour passes, with generally 4 to 7 hours aeration between passes. During each pass on the belt, the peanuts received either the full 60 minutes of heated air (60-minute exposure), or a total of 30 minutes heated air and 30 minutes ambient air (7½-, 15-, and 30-minute exposure periods).

Milling quality of the Spanish peanuts (table 4) was excellent throughout the temperature range tested. Splitting was slightly higher for peanuts that were stored under refrigeration for 5 days before drying. More off-flavors were detected in peanuts dried at 130° than at 115° F. The drying rate, based on the time the peanuts were exposed to heat, was considerably faster than in the 1965 tests. Based on total time (time peanuts were exposed to heat plus time aerated), the drying was slower, although the first harvest group of peanuts received unusually long aeration periods.

The percentage of split kernels was low for the series of tests of Runner-type peanuts (table 5), but slightly higher than that in the 1965 tests. No more split kernels were evident from peanuts having an initial moisture content of 25 to 27 percent than from those having an initial moisture content of 15 to 16 percent.

Based on the length of time the peanuts were exposed to heat, the average drying rate was considerably faster for the 1966 crop than for the 1965. But based on the total elapsed time required to reduce the moisture content of peanuts to a safe storage level, it was slower. One test lot dried in six passes with 60-minute exposure periods at 145° F. displayed significant off-flavor. This lot of peanuts was overdried, however, and since all peanuts prepared for taste evaluation received equal roasting time, they also may have been overroasted. No trend was noted in off-flavors resulting from drying temperature.

Florigiant (Virginia-type) peanuts were dried from two initial moisture levels (table 6). Significantly more split kernels resulted from peanuts that were dried at high tempera-

TABLE 4.—*Percentage of split kernels, drying rate, and number of off-flavors, belt-dried Starr Spanish peanuts, crop year 1966*

Test group, air temperature, and exposure time	Kernel moisture		Split kernels	Drying rate per hour based on—		Off-flavors [1]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	*Numbers*
Belt dried						
First harvest, 115° F.:						
Dried immediately:						
15 minutes	33 6	8 2	3 2	2.7	0.14	1
30 minutes	38 0	7 7	2 4	3.1	.16	2
60 minutes	37 2	7.4	2 5	2.1	.24	1
Stored 5 days at 50° F. before drying:						
15 minutes	30 2	7 4	3.4	2 9	.24	0
30 minutes	30 0	6 2	1.3	2 9	23	2
60 minutes	31 0	7 2	4.3	1.8	28	0
Average	-------	------	2 8	2.6	.22	1.0
First harvest, 130° F.:						
Dried immediately:						
15 minutes	34 7	7.7	2.3	3.7	.20	2
30 minutes	33 6	7.4	1.9	3.5	.20	2
60 minutes	36 1	7.0	4.6	2.6	.29	1
Stored 5 days at 50° F. before drying:						
15 minutes	26.5	7.0	4 6	3.3	.24	0
30 minutes	31.0	7.8	5.0	3.5	.27	0
60 minutes	30.5	7.1	4.7	2.3	.23	4
Average	-------	------	3.8	3.2	.25	1.5
Second harvest, 145° F.:						
Dried immediately:						
7.5 minutes	20 8	7.1	2.4	3.7	.44	-------
7.5 minutes	19.8	7.6	3.0	3.4	.41	-------
15.0 minutes	21 2	7.6	3.8	4.0	.50	-------
15.0 minutes	18.0	7.8	4 6	3.1	.39	-------
30.0 minutes	21.3	7.6	3.0	3.6	.48	-------
30.0 minutes	19 2	7.8	3.6	3.7	.44	-------
Average	-------	------	3.4	3.6	.44	-------
Bin dried (control)						
Second harvest, ambient air, continuous	--------	6 7	3.3	------	------	-------

[1] Number of panelists reporting off-flavor from a panel of 10 persons. Information provided by J. L. Pearson, horticulturist, Market Quality Research Division.

TABLE 5.—*Percentage of split kernels, drying rate, and number of off-flavors, belt-dried Early Runner peanuts, crop year 1966*

Test group, air temperature, and exposure time	Kernel moisture		Split kernels	Drying rate per hour based on—		Off-flavors [1]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	*Numbers*
First harvest						
115° F.:						
15 minutes	15.8	7 0	2 1	3.8	0.34	2
15 minutes	15.2	8 0	2 3	3 7	.25	1
30 minutes	14.9	7 2	3 3	3.7	.34	2
60 minutes	15 8	7.4	4.5	2.9	.58	2
Average	-------	------	3 0	3.5	.38	1.8
130° F.:						
15 minutes	18 0	7 2	3.1	5 1	.45	2
30 minutes	16 8	7 1	2.8	4.7	44	2
60 minutes	14.9	6 8	3.8	2.3	40	7
Average	-------	------	3 2	4.0	.43	3.7
145° F.:						
15 minutes	16.0	7.2	3.2	4.4	.41	3
30 minutes	15 3	7.4	2.8	5.9	.34	2
60 minutes	15 3	7.2	3.0	2.4	.48	1
Average	-------	------	3 0	4 2	.41	2.0
Second harvest						
115° F.:						
30 minutes	27 4	9 0	2.7	3.7	.30	8
60 minutes	25 2	8 0	3.4	2.2	.36	7
Average	-------	------	3.0	3.0	.33	5.0
130° F.:						
15 minutes	27 0	8.2	1.6	4.9	0.40	1
30 minutes	26.2	8 3	1.9	4.4	.39	1
60 minutes	26.0	7.4	3 0	3.5	54	4
Average	-------	------	2 2	4.3	.44	2.0
145° F.:						
7.5 minutes	25.2	7.6	2.9	5.5	.31	-------
15.0 minutes	25.4	6.8	5.2	4.7	.43	1
30.0 minutes	26 2	7 4	3.4	4.8	.42	2
60.0 minutes	25 9	5.8	[2] 9.4	3.6	.54	[2] 9
Average	-------	------	3.8	4.6	.42	4.0

See footnotes at end of table.

TABLE 5.—*Percentage of split kernels, drying rate, and number of off-flavors, belt-dried Early Runner peanuts, crop year 1966*—Continued

Test group, air temperature, and exposure time	Kernel moisture		Split kernels	Drying rate per hour based on -		Off-flavors [1]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	*Numbers*
Both harvests						
Average:						
6 tests, 115° F.			3 0	3 3	36	2.8
6 tests, 130° F.			2 7	4 2	44	2 8
7 tests, 145° F.			3.4	4 5	.42	3 0

[1] Number of panelists reporting off-flavor from a panel of 10 persons. Information provided by J. L. Pearson, horticulturist, Market Quality Research Division.

[2] Over-dried; omitted from average.

[3] Significant at 5-percent level.

TABLE 6.—*Percentage of split kernels, drying rate, and number of off-flavors, belt-dried Virginia peanuts, crop year 1966* [1]

Test group, air temperature, and exposure time	Kernel moisture		Split kernels	Drying rate per hour based on -	
	Initial	Final		Time exposed to heat	Total time in drying process
	Percent	*Percent*	*Percent*	*Points*	*Points*
First harvest					
Belt dried:					
115° F.:					
15 minutes	44.7	8.0	7 9	4.8	0 38
30 minutes	46.5	7.4	9 3	4.4	37
60 minutes	42 5	8.0	7 3	3 1	.41
Average			8 2	4.1	39
130° F.:					
15 minutes	47.2	8.7	9.6	4.9	.38
30 minutes	43.2	8.3	10.3	5 4	.39
60 minutes	44.2	8.2	13.5	3.5	.50
Average			11.1	4.6	.42
145° F.:					
15 minutes	46.8	7.6	14.5	6 1	.47
30 minutes	45.2	7.5	12.7	5.8	.42
60 minutes	53.8	7.6	23.3	3.8	.55
Average			16 8	5.2	.48
Bin dried (control) ambient air, continuous		7.9	3.8		

See footnotes at end of table.

TABLE 6.—*Percentage of split kernels, drying rate, and number of off-flavors, belt-dried Virginia peanuts, crop year 1966* [1]—Continued

Test group, air temperature, and exposure time	Kernel moisture		Split kernels	Drying rate per hour based on—	
	Initial	Final		Time exposed to heat	Total time in drying process
	Percent	*Percent*	*Percent*	*Points*	*Points*
Second harvest					
Belt dried:					
115° F.:					
15 minutes	29.0	9.2	4.5	4.8	.23
30 minutes	31 0	9 3	5 8	4.8	.26
45 minutes	29 5	8 3	9 2	2.9	.49
Average	----------	--------	6 5	4 0	.33
130° F.:					
15 minutes	30.6	8 0	9 8	5.2	0.46
30 minutes	28.3	8.5	7 8	5.3	.42
45 minutes	28.9	9.1	7.2	4.6	.71
Average	----------	--------	8.3	5.0	.53
145° F.:					
15 minutes	29.6	8.1	10.5	5.8	.48
30 minutes	29.2	9.7	12.1	5.4	.48
45 minutes	29.8	8.6	10.4	5.3	.85
Average	----------	--------	11.0	5.5	.60
Both harvests					
Average:					
6 tests, 115° F.	----------	--------	7.3	4.0	.36
6 tests, 130° F.	----------	--------	9 7	4.8	.48
6 tests, 145° F.	----------	--------	13.9	5.4	.54
1 test, ambient	----------	--------	3.8	--------	--------

[1] No flavor evaluations were made on peanuts from these tests.

tures or that had a high initial moisture content. The percentage of split kernels, however, was less than from tests with the belt dryer a year earlier using peanuts with corresponding moisture levels. Based on time exposed to heat, the average drying rate was faster in 1966 than in 1965, but based on total elapsed time, the average drying rate was slower.

The tests with 56R Virginia peanuts that were dried in Holland, Va., evaluated as to split kernel outturn and drying rate (table 7), showed results similar to those with the Virginia Florigiant variety. The peanuts in one series of tests conducted at Holland were exposed to 160° F. air for the first three passes. After the third pass, the air temperature was reduced 15° for two passes and an additional 15° for each two subsequent passes. The milling quality of these peanuts was not significantly different from those in the other tests, indicating that higher temperatures might be used for the first passes.

To summarize the 1966 tests, results showed that tempering, blending, and aerating the peanuts between exposures to heat generally improved the milling quality and reduced the total time of exposure to heat as compared with the 1965 tests. The Spanish- and Runner-type peanuts that were dried from an initial medium moisture level had an excellent milling quality. The milling quality of Virginia-type peanuts appeared to be affected significantly by the drying air temperature and moisture content existing at the beginning of artificial drying.

TABLE 7.—*Percentage of split kernels and drying rate, belt-dried 56R Virginia peanuts, crop year 1966* [1]

Test group, air temperature, and exposure time	Initial kernel moisture [2]	Split kernels	Drying rate per hour based on—	
			Time exposed to heat	Total time in drying process
	Percent	*Percent*	*Points*	*Points*
First harvest				
115° F.:				
15 minutes [3]	46.0	8.3	3 4	0.35
30 minutes	43 5	10.2	3 8	.30
60 minutes	43 6	8.7	2 8	37
Average	----------	9.1	3 3	.34
130° F.:				
15 minutes	45.0	7.2	5.7	.34
30 minutes	44.4	8.2	5 3	.34
60 minutes	43.0	11.2	3 6	.42
Average	----------	8.9	4.9	.36
145° F.:				
15 minutes	44.0	12.6	5 7	.36
30 minutes	42.8	7.3	5 8	.38
60 minutes	46.7	16.3	4 3	51
Average	----------	12 1	5.3	.42
Second harvest				
160° - 115° F.:				
15 minutes [4]	37 0	9.6	4.6	.39
30 minutes [5]	40 0	9.4	6.2	.45
60 minutes [6]	36.0	10.0	4.9	.72
Average	----------	9 7	5 2	.52
130° F.:				
15 minutes	38.4	10.5	4 8	.42
30 minutes	35 0	10.6	4.7	.38
60 minutes	36.0	6.8	4.0	.51
Average	----------	9.3	4 5	.44
145° F.:				
15 minutes	35 0	10.0	6.1	.47
30 minutes	34.7	14.3	5 1	.42
60 minutes	37.0	8.0	5.0	.74
----------	----------	10.8	5.4	.54

TABLE 7.—*Percentage of split kernels and drying rate, belt-dried 56R Virginia peanuts, crop year 1966* [1]—Continued

Test group, air temperature, and exposure time	Initial kernel moisture [2]	Split kernels	Drying rate per hour based on—	
			Time exposed to heat	Total time in drying process
	Percent	*Percent*	*Points*	*Points*
Both harvests				
Average:				
6 tests, 130° F.	----------	9 1	4.7	40
6 tests, 145° F.	----------	11.4	5 3	48

[1] No flavor evaluations were made on peanuts from these tests.
[2] Final moisture content approximately 8 percent for all tests.
[3] Final 3 passes were 60 minutes duration.
[4] 3 passes at 160° F., 2 at 145° F., 2 at 130° F., and 4 at 115° F.
[5] 3 passes at 160° F., 2 at 145° F., 2 at 130° F., and 2 at 115° F.
[6] 3 passes at 160° F., and 2 at 145° F.

Flavor evaluations of Spanish- and Early Runner-type peanuts indicated only one with significant off-flavor. Flavor evaluations were not performed on the Virginia peanuts or on the second-harvest Starr Spanish peanuts.

In 1967, a different method of heat control was used. The temperature of the air entering the column of peanuts was regulated to maintain a preselected maximum interstitial (between pods) peanut temperature. By doing so, a higher drying air temperature was required because of the evaporative cooling effect during early passes when the peanut moisture content was high. As the moisture content of the peanuts lowered, the air temperature required to maintain a given interstitial temperature also lowered. Tests also were conducted using constant air temperature.

The results of the 1967 tests on Spanish-type peanuts are shown in table 8. Generally, the percentage of split kernels and the drying rate were higher with either higher drying air temperature or interstitial temperature. All the peanuts dried on the belt dryer yielded more split kernels than those dried with ambient air. However, the milling quality was good considering that the peanuts were green harvested. Generally, peanuts dried on the belt dryer with 30-minute exposure periods produced fewer split kernels than for other exposure periods tested in 1967 and with no consistent difference in drying rate. The drying method in which 130° F. air temperature was used appeared to be better considering both milling quality and drying rate. Very little difference was detected in the flavor ratings of peanuts from all the 1967 tests.

The results of the 1967 tests on Runner-type peanuts are shown in table 9. The milling quality was excellent for all peanuts subjected to the drying tests, and no particular effects from any of the drying methods were indicated. The drying rate was faster with high temperatures. Peanuts from the most severe treatment, 115° F. interstitial temperature, received the lowest flavor rating.

The results of drying Florigiant peanuts at Dawson, Ga., are shown in table 10. Split kernel outturn was rather high for all treatments, but none was higher for the tests using the higher drying temperatures. Splitting was higher for peanuts in tests 1 to 10, apparently because of lower kernel moisture content at time of shelling. Although the kernel moisture content was about 10 percent for all peanuts in the tests when the drying treatments were terminated, peanuts in tests 1 to 10 were held about 4 days before shelling, allowing the kernels to further dry or "coast." The peanuts from the remaining tests were shelled within a few hours after the drying tests were completed. Again, the peanuts dried at 115° F. interstitial temperature were rated the lowest in flavor.

TABLE 8.—*Percentage of split kernels, drying rate, and flavor rating, Starr Spanish peanuts, crop year 1967*

Test group, air temperature, and exposure time [1]	Kernel moisture		Split kernels	Drying rate per hour based on—		Flavor rating [2]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	
First harvest						
Belt dried:						
90° F.,I:						
15 minutes	36 2	7 7	6 6	2 8	0 31	2.3
30 minutes	36 9	8 0	6 8	2 8	30	2.2
Average			6 7	2 8	.30	2.3
100° F.,I:						
15 minutes	40 1	8.0	6.8	3 7	41	2 1
30 minutes	38 9	7 9	6 1	3 4	34	2 4
Average			6 1	3 6	38	2.3
110° F.,I:						
15 minutes	39 2	7 8	10 9	3.9	.43	2 3
30 minutes	36 4	7 9	9 9	3 6	.37	2.7
Average			10 4	3 8	.40	2 5
115° F.,A:						
30 minutes	38 1	8 1	7 0	3 0	.32	2 4
130° F.,A:						
15 minutes	39 4	7.7	9 9	3 9	.43	2 2
30 minutes	39.7	7 7	8 9	4 0	42	2 4
Average			9 4	4 0	43	2.3
Dried in sample dryer (control):						
Ambient, continuous						2.8
Ambient, continuous						2.0
Average						2 4
Second harvest						
Belt dried:						
90° F.,I:						
15 minutes	36 8	8 5	4 7	3 2	0.36	2.2
30 minutes	38.0	8 8	5 1	3 6	.39	2.1
Average			4.9	3.4	.38	2.2

See footnotes at end of table.

TABLE 8.—*Percentage of split kernels, drying rate, and flavor rating, Starr Spanish peanuts, crop year 1967*—Continued

Test group, air temperature and exposure time [1]	Kernel moisture		Split kernels	Drying rate per hour based on—		Flavor rating [2]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	
Second harvest—Continued						
Belt dried—Continued						
100° F.,I:						
15 minutes	36 5	7 8	9 2	3 4	.36	2.8
30 minutes	37.5	9 2	5 9	3 7	.39	2.2
Average	------	------	7.6	3.6	.38	2.5
110° F.,I:						
15 minutes	37 0	9 0	9 4	4.8	.50	2.7
30 minutes	36.0	8 9	7 4	4.3	.48	2.3
Average	------	------	8 4	4.6	.49	2.5
115° F.,A:						
30 minutes	36.5	8 1	6.6	3 4	38	2.2
130° F.,A:						
15 minutes	37 5	9.2	6.6	4.5	.48	2.9
30 minutes	38.0	8.9	5 6	4.6	.47	2.2
Average	------	------	6.1	4 6	.48	2.6
145° F.,A:						
15 minutes	37 9	8 4	[3] 4 1	5.3	.52	-------
Bin dried (control):						
Ambient, continuous	37 5	10 2	4 6	------	------	-------
Dried in sample dryer (control):						
Ambient, continuous	------	------	------	------	------	2.0
Ambient, continuous	------	------	------	------	------	2.1
Average	------	------	------	------	------	2.0
Both harvests						
Average:						
90° F., I., 4 tests	------	------	5.8	3.1	0 34	2.2
100° F., I., 4 tests	------	------	7 0	3.6	.38	2 4
110° F., I., 4 tests	------	------	9.4	4.1	.44	2.5
115° F., A., 2 tests	------	------	8.8	3.2	.35	2.3
130° F., A., 4 tests	------	------	7.8	4.2	.45	2.4
145° F., A., 1 test	------	------	------	5.3	.52	-------
Ambient air, 4 tests	------	------	[4] 4.6	------	------	2.2

[1] I – Interstitial temperature, A – entering air temperature.
[2] 1 – Excellent, 2 – good, 3 – fair, 4 – poor, 5 – very poor.
[3] Value may be erroneous because of shelling procedure.
[4] One value only.

TABLE 9.—*Percentage of split kernels, drying rate, and flavor rating, Early Runner peanuts, crop year 1967*

Test group, air temperature, and exposure time [1]	Kernel moisture		Split kernels	Drying rate per hour based on—		Flavor rating [2]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	
First harvest						
Belt dried:						
95° F., I.:						
15 minutes	38.5	9.4	2.1	3 8	0 46	2 8
30 minutes	40.0	9 8	2.0	3 9	.44	2.9
Average	------	------	2.0	3.8	.45	2.8
105° F., I:						
15 minutes	38 8	8.6	2 0	4 2	45	-------
30 minutes	39 2	8.7	2 1	4.2	.46	-------
Average	------	------	2 0	4.2	46	-------
115° F., I:						
15 minutes	38.8	8.4	3.7	4.8	.55	2 8
30 minutes	38.2	8 2	2.9	4.6	.52	3.8
Average	------	------	3.3	4 7	.54	3.3
130° F., A:						
15 minutes	38.8	8.3	3 4	3 8	45	2.6
30 minutes	38.2	8.1	[3] 0.8	3.9	.45	2 9
Average	------	------	2.1	3.9	.45	2.8
145° F., A:						
15 minutes	39.4	6.6	1.9	4.5	.45	-------
30 minutes	37.6	8.5	3.5	4.0	46	-------
Average	------	------	2.7	4.3	.46	-------
Dried in sample dryer (control):						
Ambient, continuous	------	------	------	------	------	2.0
Ambient, continuous	------	------	------	------	------	2.6
Average	------	------	------	------	------	2.3

See footnotes at end of table.

TABLE 9.—*Percentage of split kernels, drying rate, and flavor rating, Early Runner peanuts, crop year 1967*—Continued

Test group, air temperature and exposure time [1]	Kernel moisture		Split kernels	Drying rate per hour based on—		Flavor rating [2]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	
Second harvest						
Belt dried:						
95° F., I:						
15 minutes	35.0	8.9	2.6	3.8	0.41	2.4
30 minutes	36.0	9.0	2.8	3.6	.46	2.9
Average	------	------	2.7	3.7	.44	2.6
115° F., I:						
15 minutes	39.0	8.4	4.4	4.9	.61	2.4
30 minutes	39.0	9.0	3.2	4.5	.54	3.1
Average	------	------	3.8	.7	.58	2.8
130° F., A:						
15 minutes	35.2	8.8	3.3	4.5	.60	2.2
30 minutes	35.6	8.5	3.4	3.9	.45	2.9
Average	------	------	3.4	4.2	.50	2.5
Dried in sample dryer (control):						
Ambient, continuous	------	------	------	------	------	2.8
Ambient, continuous	------	------	------	------	------	2.7
Average	------	------	------	------	------	2.8
Both harvests						
Average:						
4 tests, 95° F., I	------	------	2.4	3.8	0.44	2.7
2 tests, 105° F., I	------	------	2.0	4.2	.46	-------
4 tests, 115° F., I	------	------	3.6	4.7	.56	3.0
4 tests, 130° F., A	------	------	2.7	4.0	.49	2.6
2 tests, 145° F., A	------	------	2.7	4.3	.46	-------
4 tests, ambient	------	------	------	------	------	2.5

[1] I – Interstitial temperature, A–entering air temperature.
[2] 1 – Excellent, 2 – good, 3 – fair, 4 – poor, 5 – very poor.
[3] Value may be erroneous because of shelling procedure.

TABLE 10.—*Percentage of split kernels, drying rate, and flavor rating, Virginia Florigiant peanuts, crop year 1967*

Test group, air temperature, and exposure time [1]	Kernel moisture		Split kernels	Drying rate per hour based on—		Flavor rating [2]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	
First harvest						
Belt dried:						
95° F., I:						
15 minutes	39.3	6.7	13.1	4.4	0 46	3.0
30 minutes	36 4	7.1	13 6	3 3	38	2.9
Average	------	------	13 4	3 8	42	3.0
105° F., I:						
15 minutes	39 0	7.0	18 5	4 7	50	2 9
30 minutes	39 4	6 5	17.4	4 1	48	3 1
Average	------	------	17 9	4 4	.49	3.0
115° F., I:						
15 minutes	37.1	6.8	22 8	4.8	53	3 2
30 minutes	40 0	6 0	21.5	4 5	52	2.8
Average	------	------	22 2	4.6	53	3 0
130° F., A:						
15 minutes	39 2	6 5	16.5	4.7	52	2 6
30 minutes	39 2	7.0	14.2	4.0	45	2 3
Average	------	------	15.4	4.4	.49	2 4
145° F., A:						
15 minutes	39 6	7.5	20.6	4.9	.52	2.6
30 minutes	39 0	6.8	27.0	4.6	.52	2.8
Average	------	------	23.8	4 8	52	2 7
Dried in sample dryer (control): [3]						
Ambient, continuous	------	------	------	------	------	2.7
Ambient, continuous	------	------	------	------	------	3.1
Average	------	------	------	------	------	2 9
Second harvest						
Belt dried:						
95° F., I:						
15 minutes	41.2	9.4	7.6	3.9	0 37	1.9
30 minutes	48.0	9.8	10.1	4.1	.44	2.6
Average	------	------	8.8	4.0	.41	2.2

See footnotes at end of table.

TABLE 10.—*Percentage of split kernels, drying rate, and flavor rating, Virginia Florigiant peanuts, crop year 1967*—Continued

Test group, air temperature and exposure time [1]	Kernel moisture		Split kernels	Drying rate per hour based on—		Flavor rating [2]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	
Second harvest—Continued						
Belt dried—Continued						
105° F., I:						
15 minutes	40.0	8.6	10.8	4.2	41	2.7
30 minutes	40 3	8.0	13.8	3.8	.40	2.3
Average	------	------	12.3	4 0	.41	2.5
115° F., I:						
15 minutes	41.6	8.0	13 4	5.3	50	2.4
30 minutes	42.8	8.7	13.6	4.7	47	3.3
Average	------	------	13 5	5 0	.49	2.8
130°F., A:						
15 minutes	42.0	7.8	13 3	4 3	.45	2.4
30 minutes	40 1	7.5	16.4	3.8	.42	2 4
Average	------	------	14.9	4 0	.44	2.4
145° F., A:						
15 minutes	44.0	8.5	13.8	5.6	.55	2.4
30 minutes	42.0	8.2	14.0	4.8	.51	3 0
Average	------	------	13.9	5.2	.53	2.7
Dried in sample dryer (control): [3]						
Ambient, continuous	------	------	------	------	------	2 7
Ambient, continuous	------	------	------	------	------	2.1
Average	------	------	------	------	------	2.4
Ambient, continuous[4]	------	7.6	13.0	------	------	------
Both harvests						
Average:						
4 tests, 95°F., I	------	------	13 6	3 9	0 41	2 6
4 tests, 105° F., I	------	------	15 1	4 2	45	2.8
4 tests, 115° F., I	------	------	17 8	4.8	.51	2.9
4 tests, 130° F., A	------	------	15.1	4.2	.46	2.4
4 tests, 145° F., A	------	------	18.1	5 0	.52	2.7
4 tests, ambient	------	------	[5]13.0	------	------	2 6

[1] I – Interstitial temperature, A – entering air temperature.
[2] 1 – Excellent, 2 – good, 3 – fair, 4 – poor, 5 – very poor.
[3] Peanuts dried in sample dryer.
[4] Control test—peanuts dried in bin.
[5] One value only.

The results of the tests of 56R Virginia peanuts conducted in Suffolk, Va., appear in table 11. Damage was not as extensive as in the Dawson tests, though the difference may have been the result of varietal differences. Generally, the drying rate was higher and the milling quality was lower with high temperatures; however, peanuts bin-dried with ambient air and used as controls for shelling yielded an unusually large amount of split kernels for an unknown reason. Again, peanuts from the tests using 115° F. interstitial temperature were rated the lowest in flavor.

To summarize the 1967 tests, results showed that maintaining the maximum interstitial temperature at a specified level by using a high initial air temperature then reducing the air temperature on subsequent passes proved no benefit over using a constant air temperature throughout the tests. Considering milling quality, drying rate, and flavor, the 130° F. heated air method appeared to be the best of those used. Generally, no consistent differences were apparent between peanuts dried in the 15-minute exposure belt test and those dried in the 30-minute exposure test.

TABLE 11.—*Percentage of split kernels, drying rate, and flavor rating, 56R Virginia peanuts, crop year 1967*

Test group, air temperature, and exposure time [1]	Kernel moisture		Split kernels	Drying rate per hour based on—		Flavor rating [2]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	
First harvest						
Belt dried:						
95° F., I:						
15 minutes	43 8	8.9	7.1	4.2	0.30	2.7
30 minutes	43 7	7.1	9 0	4.1	.28	------
Average	------	------	8.1	4 2	29	------
105° F., I:						
15 minutes	41 8	8 6	7 4	4.4	.27	3.1
30 minutes	40 0	7 1	10.4	4.2	.29	2.7
Average	------	------	8.9	4.3	28	2.9
115° F., I:						
15 minutes	40.8	7 5	12 7	4 6	.35	3.3
30 minutes	44.5	8.1	9 2	4.9	40	2.9
Average	------	------	11.0	4 8	38	3.1
130° F., A:						
15 minutes	41.0	8.2	6 2	4.3	.27	2.0
30 minutes	41.4	8 2	7.3	4 0	.27	------
Average	------	------	6 8	4 2	.27	------
Dried in bin (control):						
Ambient, continuous [3]	46 2	8.6	12.5	------	------	------
Dried in sample dryer (control): [4]						
Ambient, continuous	------	------	------	------	------	2.4
Ambient, continuous	------	------	------	------	------	2.3
Average	------	------	------	------	------	2 4
Second harvest						
Belt dried:						
95° F., I:						
15 minutes	39.0	8.2	9.1	4.0	0.28	2.0
30 minutes	44.1	8.7	6.8	4.8	.38	------
Average	------	-----	8.0	4.4	.30	------

See footnotes at end of table.

TABLE 11.—*Percentage of split kernels, drying rate, and flavor rating, 56R Virginia peanuts, crop year 1967*—Continued

Test group, air temperature and exposure time [1]	Kernel moisture		Split kernels	Drying rate per hour based on—		Flavor rating [2]
	Initial	Final		Time exposed to heat	Total time in drying process	
	Percent	*Percent*	*Percent*	*Points*	*Points*	
Second harvest—Continued						
Belt dried—Continued						
105° F., I:						
15 minutes	44 8	9 6	5 4	4 2	35	2.4
30 minutes	42 6	7.4	5 4	4.2	34	2 3
Average	------	------	5 4	4 2	34	2 4
115° F., I:						
15 minutes	46.0	8 5	10 7	5 0	.42	2 5
30 minutes	42 4	7 8	15 1	4 2	.35	2 8
Average	------	------	12 9	4 6	38	2 7
130° F., A:						
15 minutes	41 4	8 7	6.6	4 7	.32	2 2
30 minutes	44.0	8 7	6 8	4.4	.34	------
Average	------	------	6 7	4.6	.33	------
Dried on sample dryer, (control): [4]						
Ambient, continuous	------	------	------	------	------	2 5
Ambient, continuous	------	------	------	------	------	2 3
Average	------	------	------	------	------	2 4
Both harvests						
Average:						
4 tests, 95° F., I	------	------	8.0	4.3	0.30	2 4
4 tests, 105° F., I	------	------	7 2	4 2	31	2.4
4 tests, 115° F., I	------	------	11 9	4.7	38	2.9
4 tests, 130° F., A	------	------	6.7	4 4	30	2.1
4 tests, ambient	------	------	[5]12 5	------	-----	2 4

[1] I – Interstitial temperature, A – entering air temperature.
[2] 1 – Excellent, 2 – good, 3 – fair, 4 – poor, 5 – very poor.
[3] Control test—peanuts dried in bin.
[4] Peanuts dried in sample dryer.
[5] 1 value only.

DISCUSSION

The percentage of split kernels in any lot of peanuts is an important measure of peanut quality. The reason for this is that a lower price is generally offered for split kernels than for whole kernels. The percentage of split kernels also seems to indicate peanut quality in general; that is, if split kernels are high, other quality factors are likely to be less desirable.

If high-drying temperatures are used, other factors being equal, more split kernels will almost surely result. Many other factors are involved, however, such as the length of the heat interval, location of the peanut to entering air, and the moisture content of the peanut at the start of artificial drying.

By controlling these variable factors, higher temperatures than are generally recommended were used, which resulted in a minimum of split kernels for Spanish- and Runner-type peanuts. However, temperatures above 95° F. apparently were too severe for Virginia-type peanuts under the test conditions used because their milling quality and flavor rating decreased. Intermittent exposures to temperatures up to 130° for periods up to 1 hour, followed by cooling periods, were used on low and intermediate moisture peanuts at shallow depths with little sacrifice in milling quality. This procedure resulted in increasing the drying rate to approximately twice that of bin drying. By blending and tempering the peanuts intermittently, this treatment gave even better results and higher moisture peanuts were dried without any extensive damage. Peanuts underwent heating for only about one-tenth of the total drying time. Most of the remaining time was used for low-airflow aeration in the bins. The overall drying rate of peanuts in these tests was about equal to that of continuous bin drying.

A system is needed that can apply heat in short exposures and shallow depths to about one-tenth of the peanuts involved, while the remaining nine-tenths are undergoing cooling from low-flow ambient air. With such a system only one heating unit would be required, but drying would occur simultaneously in several lots of peanuts. This system could be used easily with stationary dryers, with heated air alternating from one bin to the other by a duct and damper arrangement. However, the advantage of blending the peanuts would not be obtained. The economics of a system that would continuously blend the peanuts as they are dried should be studied.

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